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An Observational Study of Erectile Dysfunction, Infertility, and Prostate Cancer in Regular Cyclists: Cycling for Health UK Study

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Abstract

Background: Cycling is a popular sport among men. Despite its health benefits, fears have been raised regarding its effects on erectile dysfunction (ED), fertility, and on serum prostate-specific antigen levels. This study aimed to examine associations between regular cycling and urogenital abnormalities in men.
Methods: A cross-sectional population study of 5,282 male cyclists was conducted in 2012–2013 as part of the Cycling for Health UK study. The data were analyzed for risk of self-reported ED, physician-diagnosed infertility, and prostate cancer in relation to weekly cycling time, categorized as <3.75, 3.75–5.75, 5.76–8.5, and >8.5 hours/week.
Results: There was no association between cycling time and ED or infertility, disputing the existence of a simple causal relationship. However, a graded increase (p-trend = 0.025) in the risk of prostate cancer in men aged over 50 years (odds ratios: 2.94, 2.89, and 6.14) was found in relation to cycling 3.75–5.75, 5.76–8.5, and >8.5 hours/week, respectively, compared to cycling <3.75 hours/week.
Conclusions: These null associations refute the existence of a simple causal relationship between cycling volume, ED, and infertility. The positive association between prostate cancer and increasing cycling time provides a novel perspective on the etiology of prostate cancer and warrants further investigation.

Key words: cycling; epidemiology; erectile dysfunction; infertility; prostate; urogenital

Introduction

In 2012, 600 million more miles were ridden by bicycle on British roads compared to in 1993.[1] About 80% of these bicycle miles were ridden by men.[2] Increasing physical activity has many benefits; exercise intensity and frequency surpassing national guidelines has been shown to reduce the risk of type II diabetes mellitus, coronary heart disease, and stroke.[3–5] Therefore, increased physical activity and cycling in the population may herald radical improvements in the mortality and morbidity burden. Despite these potential benefits, high levels of cycling in men demand specific considerations. The effects of cycling on urogenital abnormalities such as erectile dysfunction (ED), infertility, and raised prostate-specific antigen (PSA) levels in men have been of particular interest, in addition to other issues, including hematuria, perineal soft tissue injury, priapism, and testicular cancer.[6]

These issues have been attributed to a wide range of mechanisms from the effects of repetitive trauma to risk of exposure to dangerous chemicals impregnated in bicycle saddles.[7,8] The anatomy of the perineum and the specific demands of cycling have been a major focus of investigation. The perineum contains the prostate gland and permits transit of many important neurovascular structures that supply the penis. Consequently, many urogenital abnormalities found in cyclists have been attributed to compression of these important structures. Reductions in penile blood flow and nerve entrapment syndromes have been described in cyclists with ED.[9–11] Alterations in sperm morphology among long-distance cyclists have also raised concerns regarding fertility and have been attributed to the adverse effects of elevated scrotal temperature.[11,12] In addition to this, compression of the prostate gland and changes in venous flow dynamics have been suggested to increase PSA release, which helps to explain elevated PSA levels observed in some studies of cyclists.[13,14]

As already discussed, increasing cycling levels in the population has huge potential gains for public health, particularly when only 4% of women and 6% of men reach current minimum guidelines regarding physical activity.[15] However, there is a need to understand fully the possible benefits and

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risks posed to current and prospective cyclists. But it has been difficult to examine dose–response associations between health outcomes and cycling volume because previous measurements in cross-sectional studies have been crude and cycling activity in the general population is relatively low.[16] Experimental trials using control groups to explore issues on cycling and men's health have several limitations; the smaller numbers of participants and artificial study environments used in these studies limit their statistical power and real-life meaning compared to larger observational studies. The Cycling for Health UK study aims to examine cycling habits and current health in a population of habitual cyclists. It is the largest sample size to date and provides an unparalleled opportunity to learn more about urogenital abnormalities in men who cycle. We hypothesized an association between weekly cycling volume and genitourinary problems, including ED, infertility, and prostate cancer.

Methods

Study design and participants

The study design was based on The National Runners Health Survey.[3–5,17] In the present study, an online survey was advertised via cycling magazines and UK cycling bodies from October 2012 to July 2013. The aim was to conduct a cross-sectional analysis based on participants from a variety of cycling backgrounds ranging from commuters to amateur racing cyclists. The study had ethical approval from the University College London Graduate School Ethics committee. Participation in the survey indicated informed consent.

Survey measures

The survey included questions on demographics (age, sex, and education), cycling history (number of years cycling, average weekly total and commuting cycling distance, time, speed, and best times for various standard distance competitive cycling races), weight, height, and resting heart rate (self-recorded at the radial artery from the ventral aspect of the wrist). In addition, information was collected on alcohol intake, current and past cigarette use, history of cardiovascular events (heart attacks, stroke) and any cancers, as well as treatment for or diagnosis of hypertension, high cholesterol, or diabetes. Information regarding participation in non-cycling physical activities was also collected using the International Physical Activity Questionnaire.

Outcome measures

Participants were asked to report whether they had suffered from ED in the last 5 years and then asked if they had been diagnosed with infertility or prostate cancer by a physician. Diagnoses reported before the onset of regular cycling (i.e., once per week or more) were excluded from analysis.

Statistical analysis

Multiple logistic regression was used to compute odds ratios with corresponding 95% confidence intervals (CI) for the association between cycling hours/week and ED, infertility, and prostate cancer. For these analyses, cycling hours/week was categorized into four equal groups. The models were adjusted for potential confounding factors, including age, smoking (never, previous, current), weekly alcohol intake (0 units, 1–10 units, 11–21 units, above 21 units), body mass index (BMI; normal weight, BMI $<25\,kg/m^2$; overweight, BMI $25–30\,kg/m^2$; obese, BMI $>30\,kg/m^2$), physician-diagnosed hypertension, and, lastly, for other physical activities (0 hours/week; 1–3; >3–7; >7). Analysis for cycling volume and prostate cancer was conducted among the men aged over 50 years only ($n=2{,}027$) as prostate cancer under the age of 50 years accounts for less than 1% of diagnoses.[18] Analyses were conducted using SPSS version 21.

Results

Data from 5,282 male cyclists were analyzed, although 56 participants with missing data on outcome were excluded from analyses on ED. Excluded participants did not differ in terms of their cycling characteristics. Mean age was 48.2 years (range 16–88 years); mean BMI, $25.3\,kg/m^2$ (10.1% obese); 3.8% of the cyclists sampled were current smokers; 58.6% of the sample consumed less than 21 units of alcohol per week; and 13.5% reported hypertension. Participants cycled on average 4.2 ± 1.9 days/week, for 6.5 ± 4.2 hours/week.

Self-reported ED, infertility, and prostate cancer were prevalent in 8.4%, 1.2%, and 0.8% of the sample, respectively. In the over 50-year age group, prostate cancer was reported in 1.8% of the cohort. No direct relationship was observed between cycling hours/week and ED (p-trend = 0.19) (Table 1). The strongest predictors of ED included hypertension (multivariate adjusted odds ratio = 1.94; 95% CI, 1.53–2.46), smoking (2.34, 1.46–3.73), and >60 years of age (8.70, 4.78–15.85). Years of regular cycling ranged from 1–78 years (mean 22.9 ± 18.5 years). There was no relationship between years of regular cycling (once per week or more) and ED. In sensitivity analysis, participants with less than 5 years of cycling experience were removed in order to ensure that ED symptoms were not present before the initiation of habitual cycling. However, in these analyses the association between cycling volume and risk of ED remained unchanged after controlling for age (p-trend = 0.51).

There was also no linear association between cycling and infertility (p-trend = 0.14), although cycling 3.75–5.75 hours/week was associated with decreased odds of infertility (odds ratio = 0.44; 95% CI, 0.21–0.94) (Table 2).

Physician-diagnosed prostate cancer in those aged over 50 years, however, demonstrated a direct dose–response relationship with cycling hours/week after adjusting for possible confounding variables, including age. Cycling 3.75–5.75,

Table 1. Association Between Cycling and Erectile Dysfunction in Men ($N=5{,}227$)

Weekly cycling time (hours/week)	*Cases/n*	*Model 1, odds ratio (95% CI)*	*Model 2, odds ratio (95% CI)*
<3.75	124/1,269	Ref.	Ref.
3.75–5.75	88/1,223	0.75 (0.56–1.00)	0.75 (0.55–1.01)
5.76–8.5	114/1,492	0.79 (0.60–1.04)	0.79 (0.60–1.05)
>8.5	115/1,243	0.87 (0.66–1.15)	0.92 (0.69–1.23)

Model 1: adjusted for age.
Model 2: adjusted for age, smoking, body mass index, hypertension, alcohol intake, and other physical activities.

Table 2. Association Between Cycling and Infertility in Men (N=5,282)

Weekly cycling time (hours/week)	*Cases/*n	*Model 1, odds ratio (95% CI)*	*Model 2, odds ratio (95% CI)*
<3.75	21/1,288	Ref.	Ref.
3.75–5.75	10/1,237	0.50 (0.23–1.06)	0.44 (0.21–0.94)
5.76–8.5	18/1,504	0.74 (0.39–1.40)	0.64 (0.34–1.22)
>8.5	14/1,253	0.67 (0.34–1.32)	0.56 (0.28–1.11)

Model 1: adjusted for age.
Model 2: adjusted for age, smoking, body mass index, hypertension, alcohol intake, and other physical activities.

5.76–8.5, and >8.5 hours/week versus <3.75 hours were associated with odds ratios of 2.94 (95% CI, 0.74–11.64), 2.89 (95% CI, 0.76–10.96), and 6.14 (95% CI, 1.73–21.76) of being diagnosed with prostate cancer, respectively (p-trend = 0.025) (Table 3). In order to check that these results were not explained by increased health-seeking behavior, associations between cycling volume and yearly consultations with primary care physicians were examined. Yearly consultations with primary care physicians were not associated with cycling volume in men aged over 50 years. Overall, 48% of participants reported visiting their primary health physician once or twice in the past year, with no statistically significant difference between cycling volume groups (p-value = 0.52). This suggests that higher activity levels were not associated with increased health-seeking behavior.

The validity of self-reported cycling volume was analyzed by correlating resting heart rate with reported physical activity, since low resting heart rate is representative of aerobic conditioning. A significant inverse relationship was observed between self-reported cycling volume and resting heart rate consistent with increased cardiovascular fitness. Cycling volume was measured by hours spent cycling per week and metabolic equivalent of task values (MET-hour), which are ratios of energy expenditure relative to resting metabolic rate. Each MET-hour/week of cycling was associated with −0.07 beats/minute (95% CI, −0.08 to −0.06) reduction in heart rate after adjusting for age.

Discussion

In this large cross-sectional observational study of cyclists, weekly cycling duration was not associated with ED or infertility. However, a dose–response association between cycling time and prostate cancer was demonstrated, which was particularly marked in participants cycling over 8.5 hours/week. Causality cannot be inferred from these cross-sectional associations, nor can they completely discount previous suggestions that high cycling activity can lead to infertility and ED. Well-designed randomized controlled trials can help to clarify the direction and extent of causation. However, this study is one of many similarly designed works on exercise and health that use large cross-sectional analysis to provide sufficient statistical power to demonstrate biological gradients between exercise and health outcomes.[3–5] Biological gradients between risk factor exposure and health outcomes are key features in describing causal relationships in epidemiological data. Although our data cannot confirm causality on its own, this study—the biggest study to date looking at the health of cyclists—provides important population data showing associations of cycling volume with ED, infertility, and prostate cancer among habitual cyclists.

Numerous studies have observed a link between cycling and ED. Andersen and Bovim[19] surveyed 160 cyclists participating in a 540 km annual Norwegian bike tour: 21% of males reported penile numbness and 13% reported symptoms of impotence, 11% of whom experienced symptoms for longer than 1 week. Indeed, several epidemiological investigations of ED and cycling have studied participants during mass-participation cycling events.[19–21] A major limitation of these studies, however, is that mass-participation events can see amateur cyclists cycling above and beyond their normal volumes. Studying these cyclists undertaking such unusual activity over a short period of time leaves little opportunity to see their symptoms plateau and subside. Indeed, cycling versus inactivity has been shown to be a protective factor for ED.[22]

The Bradford Hill criteria for causation stipulate that strength of association, consistency, specificity, experimentation, plausibility, coherence, temporality, analogy, and biological gradients are important factors to infer causation.[23] Studies investigating ED in cyclists posit highly plausible explanations for the phenomena and, indeed, there is compelling evidence by strength of association, using observational as well as experimental study design; however, none have been able to demonstrate a biological gradient.[9,10,19–21,24,25] In this study, 441 cases of ED were identified (8.4% of the cohort); however, a biological gradient between cycling hours/week could not be identified, which suggests that there is not a simple causal relationship between cycling and ED. This was unlikely to be confounded by participants cycling less as a consequence of ED as similar numbers of cases were found in groups <3.75, 3.75–5.75, 5.76–8.5, and >8.5 hours/week. Indeed, it could be that participants had previously been diagnosed but their symptoms have subsequently subsided, allowing them to return to their normal cycling

Table 3. Association Between Cycling and Prostate Cancer in Men Aged Over 50 Years (N=2,027)

Weekly cycling time (hours/week)	*Cases/*n[a]	*Model 1, odds ratio (95% CI)*	*Model 2, odds ratio (95% CI)*
<3.75	3/511	Ref.	Ref.
3.75–5.75	7/449	2.91 (0.74–11.38)	2.94 (0.74–11.64)
5.76–8.5	9/569	2.79 (0.75–10.41)	2.89 (0.76–10.96)
>8.5	17/498	5.26 (1.52–18.17)	6.14 (1.73–21.76)
p-Trend		0.046	0.025

Model 1: adjusted for age.
Model 2: adjusted for age, smoking, body mass index, hypertension, alcohol intake, and other physical activities.
[a]Men reporting other types of cancer were removed from analysis.

volumes. In this study, data on self-reported ED in the past 5 years were collected. In contrast to the other survey measures, a physician diagnosis was not required; this is because ED can often be underreported. Furthermore, in contrast to studies using mass-participation cycling events,[19–21] this population of habitual cyclists demonstrated a lower proportion of ED, which demonstrated no direct relationship with cycling volume. This study questions the simple causal relationship between cycling and ED that has been inferred by prior studies.

Several large community-based studies of ED have been conducted in the United States. In the Massachusetts Male Aging Study (MMAS),[26] an overall prevalence of 52% ED was reported. In the U.S. National Health and Social Life Survey, the prevalence of sexual dysfunction in males (not specific ED) was 31%.[27] In a European study, the Cologne study of men aged 30–80 years, the prevalence of self-reported ED was 19.2%, with a steep age-related increase from 2.3% to 53.4%.[28] However, the prevalence of ED in this cohort (8.4%) is lower than that in other studies. Several reasons might account for this: one reason might be differences in the questionnaires used to assess ED; another could be that the cyclists studied had relatively low rates of risk factors for ED (e.g., smoking and hypertension) compared with the general population. Indeed, results of MMAS demonstrated lower rates of ED among cyclists compared to noncyclists; this was attributed to improved cardiovascular health among cyclists.[26] Nevertheless, after cross-sectional analysis, there was no biological gradient between cycling and ED. Furthermore, the prevalence of ED was lower than that in studies on the wider population. With this in mind, this study emphasizes that cycling and ED may not share a simple cause-and-effect relationship. The previous studies exploring ED and cycling may overemphasize its significance among regular cyclists and do not account for the cardiovascular benefits that can prevent ED.

There was no direct relationship between cycling hours/week and risk of infertility. Compared to cycling <3.75 hours/week, cycling 3.75–5.75 hours/week was associated with a reduced odds ratio of 0.44 (95% CI, 0.21–0.94), which reached statistical significance. This association was not statistically significant at higher cycling volumes. Although it is difficult to interpret the importance of the observed protective effect of cycling 3.75–5.75 hours/week observed in the cohort, the low prevalence of infertility and absence of direct relationship is important. The absence of a positive association between cycling and infertility allays concerns raised by previous studies about observed alterations in sperm characteristics in cyclists.[11] It would have been of interest to determine the sperm characteristics of the men before initiation of habitual cycling, although these data were not collected. Nevertheless, this study demonstrates that concerns regarding male infertility and cycling have not been born out in a large cross-sectional analysis.

The findings of this study demonstrated a direct relationship between risk of prostate cancer and cycling volume in cyclists aged over 50 years. This association was statistically significant after controlling for key confounding variables, including age. In addition, there was no association between cycling volume and primary care contact, suggesting that these findings are not simply because of increased health awareness. To the best of our knowledge, this is the first study to demonstrate an association between prostate cancer and cycling, so there are no studies hypothesizing a pathophysiological mechanism for such a link. Perineal trauma may represent the underlying pathophysiology. Testicular cancer has been linked to cycling because of repetitive trauma to scrotal contents.[8] Indeed, prostatitis has been described in cyclists[6] and a meta-analysis has demonstrated that a history of prostatitis is associated with an increased risk of prostate cancer.[29] The prevalence of prostatitis among cyclists is difficult to ascertain owing to a lack of evidence. Nevertheless, the effects of repetitive trauma on the prostate and carcinogenesis may be interesting avenues of study that may complement these findings. However, further prospective evidence is required to confirm this link. Indeed, it may be that cycling increases rates of diagnosis rather than risk of developing pathology. PSA has been found to be elevated in long-distance cyclists aged over 50 years.[14] In addition, urogenital complaints such as hematuria, known as ‘‘bike-seat hematuria,’’ perineal soft-tissue lesions, ED, and perineal sensory abnormalities that are associated with cycling[6] may lead to increased rates of investigation and subsequent diagnosis of other underlying conditions. This is speculative, however, but the presence of a biological gradient, and a compelling strength of association between prostate cancer and high cycling volumes warrant further investigation.

This study is subject to a number of important caveats. Since the study was Internet-based, there was no opportunity for interview or physical examination, which limits the ability to explore the reported diagnoses further. Moreover, the cross-sectional design limits our ability to infer causality; however, in contrast to previous observational studies, the data are free of selection bias for ED, infertility, and prostate cancer. The use of self-reporting is also subject to certain inaccuracies; however, previous studies have shown self-reported ED and prostate cancer to be reliable.[25,30] Data are lacking regarding self-reported infertility in men; however, women have been found to self-report infertility with good accuracy.[31] In addition, the nature of the study design, an anonymous online questionnaire, is likely to reduce embarrassment of reporting ED and infertility, thus potentially increasing the validity of the self-report. The use of self-reported physical activity levels is commonly used in this field of research.[3–5,17] The self-reported physical activity data were also internally validated by an inverse dose–response relationship with resting heart rate, which is reflective of a physiological bradycardia seen in higher levels of aerobic fitness.

Conclusion

In a large, detailed cross-sectional study of habitual cyclists, we present findings regarding the association between self-reported cycling time and ED, infertility, and prostate cancer. There was no biological gradient between cycling time and ED or infertility, which is at odds with previous suggestions of a causal relationship. The findings suggest a graded association between cycling and risk of prostate cancer, but whether this is a definitive association related to causation or diagnosis remains to be seen.

Author Contributions

Dr. Hamer had full access to the data to perform all analyses and takes responsibility for the integrity and accuracy of the results. Mr. Hollingworth drafted the article. Mr. Hollingworth and Dr. Hamer designed the study. Mr. Hollingworth and Dr. Harper collected the data. All authors were responsible for interpretation of data and critical revision of the article. All

authors have approved the final version to be published. The funder had no role in the study design; in the collection, analysis, and interpretation of data; in writing of the report; or in the decision to submit the article for publication.

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Author Disclosure Statement

None of the authors report any conflict of interest.

References

1. Department of Transport Statistics. Pedal cycle traffic (vehicle miles/kilometres) in Great Britain, annual from 1949. Available at www.gov.uk/government/statistical-data-sets/tra04-pedal-cycle-traffic Last accessed April 12, 2014.
2. Keep M. House of Commons. Road cycling: Statistics—Commons Library Standard Note. Available at www.parliament.uk/briefing-papers/SN06224 Last accessed November 20, 2013.
3. Williams PT. Changes in vigorous physical activity and incident diabetes in male runners. Diabetes Care 2007;30:2838–2842.
4. Williams PT. Reductions in incident coronary heart disease risk above guideline physical activity levels in men. Atherosclerosis 2010;209:524–527.
5. Williams PT. Reduction in incident stroke risk with vigorous physical activity: Evidence from 7.7-year follow-up of the national runners' health study. Stroke 2009;40:1921–1923.
6. Leibovitch I, Mor Y. The vicious cycling: Bicycling related urogenital disorders. Eur Urol 2005;47:277–286.
7. Lehmann K, Schopke W, Hauri D. Subclinical trauma to perineum: A possible etiology of erectile dysfunction in young men. Eur Urol 1995;27:306–310.
8. Coldman AJ, Elwood JM, Gallagher RP. Sports activities and risk of testicular cancer. Br J Cancer 1982;46:749–756.
9. Nayal W, Schwarzer U, Klotz T, Heidenreich A, Engelmann U. Transcutaneous penile oxygen pressure during bicycling. BJU Int 1999;83:623–625.
10. Ricchiuti VS, Haas CA, Seftel AD, Chelimsky T, Goldstein I. Pudendal nerve injury associated with avid bicycling. J Urol 1999;162:2099–2100.
11. Gebreegziabher Y, Marcos E, McKinon W, Rogers G. Sperm characteristics of endurance trained cyclists. Int J Sports Med 2004;25:247–251.
12. Jung A, Strauss P, Lindner HJ, Schuppe HC. Influence of moderate cycling on scrotal temperature. Int J Androl 2008;31:403–407.
13. Oremek GM, Seiffert UB. Physical activity releases prostate-specific antigen (PSA) from the prostate gland into blood and increases serum PSA concentrations. Clin Chem 1996;42:691–695.
14. Mejak SL, Bayliss J, Hanks SD. Long distance bicycle riding causes prostate-specific antigen to increase in men aged 50 years and over. PLoS One 2013;8:e56030.
15. Health and Social Care Information Centre. Health, social care and lifestyles—Summary of key findings. In: Health Survey for England 2011. Available at https://catalogue.ic.nhs.uk/publications/public-health/surveys/heal-surv-eng-2011/HSE2011-Sum-bklet.pdf Last accessed December 2, 2013.
16. Matthews CE, Jurj AL, Shu XO, et al. Influence of exercise, walking, cycling, and overall nonexercise physical activity on mortality in Chinese women. Am J Epidemiol 2007;165:1343–1350.
17. Williams PT. Relationship of distance in per week to coronary heart disease risk factors in 8283 male runners. Arch Intern Med 1997;157:191–198.
18. Cancer Research UK. Prostate cancer incidence statistics. In: Cancer Stats. 2013. Available at www.cancerresearchuk.org/cancer-info/cancerstats/types/prostate/incidence/#source1 Last accessed December 11, 2013.
19. Andersen KV, Bovim G. Impotence and nerve entrapment in long distance amateur cyclists. Acta Neurol Scand 1997;95:233–240.
20. Kuland D, Brubaker C. Injuries in the Bikecentennial tour. Phys Sportsmed 1978;6:74–78.
21. Weiss BD. Nontraumatic injuries in amateur long distance bicyclists. Am J Sports Med 1985;13:187–192.
22. Marceau L, Kleinman K, Goldstein I, McKinlay J. Does bicycling contribute to the risk of erectile dysfunction? Results from the Massachusetts Male Aging Study (MMAS). Int J Impot Res 2001;13:298–302.
23. Höfler M. The Bradford Hill considerations on causality: A counterfactual perspective. Emerg Themes Epidemiol 2005;2:11.
24. Sommer F, Schwarzer U, Klotz T, Caspers HP, Haupt G, Engelmann U. Erectile dysfunction in cyclists. Is there any difference in penile blood flow during cycling in an upright versus a reclining position? Eur Urol 2001;39:720–723.
25. O'Donnell AB, Araujo AB, Goldstein I, McKinlay JB. The validity of a single-question self-report of erectile dysfunction. Results from the Massachusetts Male Aging Study. J Gen Intern Med 2005;20:515–519.
26. Feldman HA, Goldstein I, Hatzichristou DG, Krane RJ, McKinlay JB. Impotence and its medical and psychosocial correlates: Results of the Massachusetts Male Aging Study. J Urol 1994;151:54–61.
27. Laumann EO, Paik A, Rosen RC. Sexual dysfunction in the United States: Prevalence and predictors. JAMA 1999;281:537–544.
28. Braun M, Wassmer G, Klotz T, Reifenrath B, Mathers M, Engelmann U. Epidemiology of erectile dysfunction: Results of the "Cologne Male Survey." Int J Impot Res 2000;12:305–311.
29. Dennis LK, Lynch CF, Torner J. Epidemiologic association between prostatitis and prostate cancer. Urology 2002;60:78–83.
30. Sayre EC, Bunting PS, Kopec JA. Reliability of self-report versus chart-based prostate cancer, PSA, DRE and urinary symptoms. Can J Urol 2009;16:4463–4471.
31. de Boer EJ, den Tonkelaar I, Burger CW, van Leeuwen FE; OMEGA Project Group. Validity of self-reported causes of subfertility. Am J Epidemiol 2005;161:978–986.

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